DOCUMENT RESUME

ED 089 216 CS 000 986

AUTHOR Caldwell, Robert M.
TITLE Literacy Development Using a Programmed Text and Computer Assisted Instruction.
PUB DATE Apr 74
NOTE 23p.; Paper presented at the Annual Meeting of the American Education Research Association (Chicago, April 15-19, 1974)

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS Adolescents; *Computer Assisted Instruction; *Educational Research; Functional Illiteracy; Individualized Instruction; *Programed Texts; *Program Evaluation; Reading Improvement; *Reading Instruction; Secondary Education
IDENTIFIERS *Literacy Development Program

ABSTRACT

The purposes of this study were to evaluate the effectiveness of a Literacy Development Program using the computer as a means of adjusting reading instruction to the varying abilities of illiterate and semi-literate adolescents and adults, and to compare the effectiveness of the literacy materials presented through the computer system with the effects achieved by identical materials presented through a programed text. Subjects used in this investigation were enlisted from five high schools in Centre County, Pennsylvania; They ranged fourteen to eighteen years old and read below fifth grade level. Some of the findings were that reading materials sequenced for instruction in both the programed text and a computer-based display unit were successful in producing significant differences between pretest and posttest achievement; the programed text and the computer-based display unit were equally effective; further study needs to be made into the effect of mechanical problems encountered in the use of computer systems as they influenced student achievement; students using the computer-assisted reading materials were more positive in their attitudes toward that medium than students using the programed text; and students using the computer system spent an average of eighteen minutes longer at the instructional task than those using the programed text. (RB)

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

11.03

ED 089216

BEST COPY AVAILABLE

LITERACY DEVELOPMENT USING A PROGRAMMED TEXT AND COMPUTER ASSISTED INSTRUCTION

Presented by

Robert M. Caldwell
Southern Methodist University

At

American Educational Research Association
1974 Annual Meeting

Chicago

Session No. 11.03

BEST COPY AVAILABLE

CS 000 984

BEST COPY AVAILABLE

INTRODUCTION

In a recent issue of Learning magazine, a national publishing company displayed an advertisement extolling the virtues of an array of newly developed reading materials. These materials, they claimed, had brought "dramatic results" when used by an enterprising young woman who had carried them about Marin County, California in her "tutorbus." Her approach, it seems, was to pull into a school parking lot, set up a mini-reading clinic, and proceed to work magic on"problem learners" with the aid of the new reading program.

The publishing company, of course, would have us believe that the reading materials themselves had produced the improvement in the learner's reading ability. While this possibility cannot be discounted, a considerable amount of research exists to support the notion that the teacher's ability to individualize the reading instruction was really the key variable in the success of her program. Goff (1964), Johnson (1965), Talbert and Merrit (1965), Spencer (1967), Rothrock (1961) and others have all found gains in reading achievement and in the development of more favorable attitudes toward reading when instruction was adjusted to the learner's level of achievement, interest, and need. Their research found that an individualized approach offers advantages over other methods in that it adjusts to individual progress in the sub-skills by teaching to points of weakness and provides for more opportunities for interaction and feedback from the teacher

than do group analysis techniques. Teachers, however, are frequently concerned about the best ways to organize for individualized reading and what materials best facilitate such an approach.

The recent emergence of technology and its applications to instruction seems to offer great potential for this purpose. Programmed reading, for example, has enjoyed great success as a means for individualizing instruction. Goss (1964) found that first grade classes using the Sullivan Reading Program have achieved significantly higher scores on reading tests than have traditionally taught classes. In fact, the mean score in reading achievement for classes using Programmed Reading (1964) was higher than the mean of any class in the state of California taught with the state adopted reading textbooks. Fry (1968), Kaufman (1968), and Ruddell (1965) have also reported favorable results from studies done using programmed reading materials.

Programmed materials adapted to computer capabilities have also proven quite effective for individualizing reading instruction. Research done at Stanford University using the computer as a medium for teaching initial reading has produced significant gains in reading achievement for first and second grade learners (Fletcher and Atkinson, 1972). Majer (1972) has summarized several research studies which found significant achievement gains resulting from reading instruction presented under computer control and indicated that learners exposed to Computer Assisted Instruction (CAI) expressed overwhelming acceptance of the computer in place of a teacher.

Despite these reports of success with programmed reading texts and computer assisted reading instruction, however, experts are divided over the efficacy of either medium for improving reading skills. Suppes (1968), for example, feels that a program is best used in a computer. The machine, he contends, has the advantage in that it can provide control over the learning situation, recording student progress and adapting the instructional sequence accordingly. A further advantage, he feels, is the computer's speed of operation; because or it, large numbers of students can be handled simultaneously, all progressing from different points in the curriculum. Jacobs, Maier, and Stolurow (1966) point out that the computer has the capability of combining teaching strategies with a variety of audio-visual presentations simultaneously, something that is quite difficult to accomplish with a programmed text.

Kaufman (1968), on the other hand, points out that a programmed text in many respects offers certain advantages over a computer based program. In a study he conducted evaluating the Sullivan Programmed Reading program, Kaufman found that groups using the programmed text not only were successful in acquiring vocabulary and other reading skills but also produced better quality writing. He attributed this to the fact that the responses required in the programmed text were largely written, a skill not utilized when using computer assisted instruction.

Pry suggests that the programmed text actually allows more flexibility in the educational program than does the computer because it can be shipped or carried anywhere or used in almost any

setting. The computer, on the other hand, is restricted by its cumbersome hardware and problems of maintenance and repair. Kaufman (1968) also feels that the computer in many ways restricts or limits the learner. With the programmed text, he feels, learners are freer to work in groups and participate in peer tutoring; they are not obligated to interact solely with the machine. Jacobs, Maier, and Stolurow (1966) point out that, "The software alone can be used in a variety of settings and does not usually require special facilities. It is especially useful in teaching courses for which there is only small demand (p. 19)."

Knezevich and Eye (1970) perhaps summarize the essence of the controversy:

> Most experiments demonstrate the feasibility of presenting instructional materials in the CAI format, but comparatively little research has shown whether it is a better way to stimulate learning or whether it is a less expensive way to develop certain skills and insights. It remains to be proved experimentally that CAI is superior to all other approaches...Presenting a question and answer on the cathode-ray-tube may not be much different from presenting them on a piece of paper (p. 65).

Research conducted recently at the Pennsylvania State University Computer Assisted Instruction Laboratory has sought to find at least a partial solution to this controversy by exploring some of the instructional benefits unique to each medium for developing literacy skills in semi-literate adolescents.

PURPOSE AND OBJECTIVES OF THE STUDY

Since January 1972, a Literacy Development Program has been under development at the Pennsylvania State University CAI Laboratory exploring the potential of the computer as a means of adjusting reading instruction to the varying abilities of illiterate and semi-literate adolescents and adults. One unique feature of this program is that it attempts to provide as reading content career information which will assist the learner in preparing for the job world. Learning segments have been sequenced for instruction under computer control and are designed to provide for the development of comprehension, vocabulary, and syntactic word skills at a variety of reading levels. Career information has been written to supply job, task, and technical descriptions for a variety of occupational categories that appeal to both male and female interests.

Evaluation of this program was carried out at two levels. On one level an attempt was made to assess the effectiveness of the reading instruction as it was presented exclusively under computer control. The only variable under investigation here was the difference in vocabulary, comprehension, and combined achievement from pretest to posttest. A more detailed description of this evaluative stage is presented by Golub (1974).

The second level of assessment compared the effectiveness of the literacy materials presented through the computer system with the effects brought about by identical materials presented through a programmed text. More specifically, the measured effectiveness of each medium was determined by its ability to:

1. Produce significant gains in reading achievement from pretest to posttest.

2. Create favorable attitudes in learners

3. Increase instructional efficiency so that specified learning outcomes could be met in fewer contact hours with the learner at a cost within the limits of most school budgets.

The study was also designed to investigate relationships between learner preference for either the computer based system or the programmed text and their reading achievement.

PROCEDURES OF THE INVESTIGATION

Population and Sampling Procedures

Subjects used in this investigation were enlisted from five high schools in Centre County, Pennsylvania. All ranged in age from 14 to 18 and were identified by their respective guidance counselors as having reading levels below fifth grade. Unfortunately, these grade placements were determined by separate reading achievement tests used by the individual school districts. As a result, they provided no standard determination of reading achievement. It was assumed, however, that these schools used valid evaluation instruments for assessing student abilities and that for this reason the population used in the study represented a valid sample of semi-literate adolescents.

Students were randomly assigned to the treatment groups and made aware that they were participating in an experimental program of reading instruction. Every effort was made to insure equivalent interest and enthusiasm in controlling for differences which might have occured from a "Hawthorne Effect." None of the students using computer assisted instruction had ever been exposed to this medium and few of those using the programmed text had ever worked on that

medium before. All subjects were white males and females from middle and lower-middle income families living in rural communities.

Treatment

Data were collected on 13 males and 5 females who worked on literacy materials presented through a computer based display unit and on 10 females and 28 males who worked on the same materials adapted to a programmed text.

The reading materials presented through the computer based display unit were made available through an IBM 1500 Instructional System. This basic configuration consists or a central process computer with accompanying disc-storage units, proctor stations, and an interphase of 33 student display units. The central process computer acted as an intermediary between each student and the reading program which was stored in one of the disc-storage units. The display unit itself consisted of a random-access audio unit and picture display unit and a cathode-ray-tube with accompanying light pen and character generation response systems.

Reading instruction presented through the display unit integrated both audio and visual channels in a "tutorial" mode of student-system interaction. This system has the capability for real-time decision making and instructional branching dependent upon the learner's individual response history. This level of interaction also proved highly adaptable to the programmed text presentation. By using a programming technique developed by N. A. Crowder known as "intrinsic programming," the same variability

offered by the tutorial system was made available to the student in the programmed text. In essence, the content of the reading instruction presented in each medium was as similar as was possible within the limits of the media themselves. In the programmed text the absence of audio assistance was the only content difference.

Experimental Design

The research design used for this study was the "Nonequivalent Control Group Design" discussed by Campbell and Stanley (1963, pp. 47-50) and represents essentially a pretest-treatment-posttest procedure for each experimental group. In this design the groups under study do not have pre-experimental sampling equivalence.

Instrumentation

Differences in pretest and posttest reading achievement were measured using a 31 item criterion referenced test. This test was designed to assess mastery of criterion skills in vocabulary development, reading comprehension, and development of syntactic word skills.

Measures of learner attitudes toward CAI and programmed text presentations were taken using a 25 item Semantic Differential Scale. This scale was developed by Peters and Rookey (1969) and was used successfully by Mull (1973) in her study comparing attitudes toward CAI and a programmed workbook.

Data Collection Procedures

Pretest and posttest achievement scores, minutes spent in instruction and item response analyses for the group using the computer based system were automatically collected and stored by the computer. The criterion referenced pretest and posttest were

programmed for on-line administration through the student terminal, utilizing all available presentation and response channels.

The group using the programmed text was given a pencil and paper version of the pretest and posttest although procedures for administration of tests to both groups were strictly controlled in an effort to make them as much the same as possible. In addition, both groups were made to feel as if they were participating in a special program in an effort to control for any "Hawthorne Effect."

The pretest for the programmed instruction group was administered on May 14, 1973 and students worked on the reading materials for a period of ten days. On May 24, 1973 the posttest was given by classroom teachers who had monitered the programmed text instruction. Students using the CAI program took the pretest and posttest and worked on the computer program at various times between April 23, 1973 and May 11, 1973.

The Semantic Differential was administered in a pencil and paper format to each group upon completion of the individual treatments and were machine scored. Each pair of bipolar adjectives was read and explained to the subjects by the test proctor so that the accurate assessment of attitudes would not be inhibited by the subjects' inability to read and comprehend the terms used on the Semantic Differential.

Instructional times were collected in two ways. Learners using the programmed text recorded the times they began and finished each unit of the text and data was then collected from these student records. Times for the CAI group were automatically recorded by

the computer.

STATISTICAL ANALYSIS AND INTERPRETATION

Hypothesis 1

Semi-literate adolescents using a self-instructional reading program made available through a computer based display unit will achieve significantly higher scores ($p < .05$) on a criterion referenced reading test than semi-literate adolescents using the same reading content in a programmed text.

Means and standard deviations derived from pretest and posttest assessment indicated that both groups made gains in reading achievement regardless of the medium they used. But they also indicated that neither the CAI nor the programmed presentation of the literacy material was more successful than the other in bringing about more significant achievement gains. Pretest and posttest scores are summarized in Table 1.

TABLE 1

Reading Achievement Pretest and Posttest Means and Standard Deviations for CAI and PI Semi-literate Adolescents

Groups	N	Pretest		Posttest	
		Mean	SD	Mean	SD
CAI	18	19.17	4.22	22.22	3.28
PI	35	20.09	3.87	23.54	4.69

Analysis of this data using an Analysis of Variance with Repeated Measures (ANOVR) confirmed these initial assumptions. A non-significant F ratio of 1.07 obtained from the ANOVR indicated that there was no significant difference in the main effect

for treatment; this meant that the group using the computer assisted reading program did not differ significantly from the programmed text group on either pretest or posttest achievement. Interaction between achievement and treatment yielded a non-significant F of .15, confirming the indication that neither the CAI nor the programmed text had a differential effect on achievement. However, an F of 43.31 ($p < .001$) indicated that differences in pretest and posttest achievement were significant for each group.

Hypothesis 2

Posttreatment attitude scores on a semantic differential scale obtained from semi-literate adolescents using a computer based display unit will be significantly more positive than scores on the same scale obtained from semi-literate adolescents using a programmed text.

Mean scores calculated from data collected with the semantic differential scale revealed that both groups had relatively positive attitudes toward the instructional medium they used. Mean attitude responses were based on the following scale:

Extremely Negative	Neutral	Extremely Positive
25	100	175

Means and standard deviations for both groups are shown in Table 2.

TABLE 2
Means and Standard Deviations of CAI and PI Attitude Scores on the Semantic Differential

Group	N	Mean	SD	d.f.	t value
CAI	17	136.29	25.82	54	2.85*
PI	38	118.29	14.16		

*Significant at .05 level

A comparison of means using a t test for independent groups supported Hypothesis 2, indicating that attitudes of those subjects using the CAI reading program were significantly more favorable toward that medium than the programmed instruction group was toward the programmed text.

Ancillary Question #1

Is there any relationship between posttest reading achievement and measures of attitude toward a particular instructional medium?

Pearson Product Moment Correlations of posttest achievement and posttreatment attitude measures indicated that there was no significant correlation between achievement and attitudes toward the medium used.

Ancillary Question #2

Is the mean time spent at the instructional task greater for those learners using computer assisted reading instruction or for those using a programmed text?

Mean instructional times recorded for each group indicated that the learners using the computer assisted program spent an average of 18 minutes longer at the instructional task than those using the programmed reading text. A Mann-Whitney U test indicated that this mean difference was significant at the .05 level.

SUMMARY DISCUSSION AND CONCLUSIONS

Discussion of Results

Several findings in this study seem important for discussion. First, it was found that reading materials sequenced for instruction in a programmed text and a computer-based display unit were successful in producing significant differences between the pretest and posttest achievement of semi-literate adolescents using those media. This fact seems to support a great deal of earlier research which has shown computer assisted and programmed instruction to be extremely effective means for individualizing the instructional process.

It was also found, however, that when compared with each other, neither the programmed text nor the computer-based display unit taught more successfully than the other. This finding corroborated studies by Mull (1973) and Phillips (1971) who had found similar results. It might be pointed out here, however, that the results of this study could have had greater validity if a third group could have been introduced for greater control for the effects of treatment. This group could have been pretested and posttested without benefit of treatment to assess the amount of reading gain which might have occurred by chance alone.

This procedure was not followed in this study for two reasons. First, some difficulty was encountered in obtaining a readily available sample population. As it was, nearly every semi-literate learner within a reasonably accessible area was enlisted. Also, certain time and cost restrictions limited the search for appropriate subjects. Further research in this area, however, might

benefit from the addition of such a group.

A number of characteristics unique to each media were noticed in this study which might prove valuable in doing further research. One characteristic of the computer system was that a number of mechanical problems were encountered which might have influenced student achievement. On many of the items in the computer-assisted presentation, the learner was required to respond using the typewriter keyboard. Many of the subjects had not had much experience with a typewriter before and this, combined with the fact that typed responses were immediately visible on the cathode-ray-tube, was somewhat overwhelming and intimidating. It was observed that many errors were made in responding to questions, not because the student did not know the correct answer, but because he did not know how to correct a typing error before entering his answer into the computer. As a result, the incorrect answer was entered by the student anyhow so that he could move on to the next question. No data is available from this study to indicate that more errors were made on those items requiring a typed response than on those requiring a light pen response, but it is a factor which might be considered in further studies. Dick (1965) has already contributed to this point to some degree in a study where he found that when poor typists are permitted to score their own implicit responses rather than type them out, their performance is markedly better.

Another finding of the study was that students using the computer-assisted reading materials were overwhelmingly more positive in their attitudes toward that medium than those students

using the programmed text. Two factors seem important in this finding. First, none of the subjects who used the computer-based display unit had ever been exposed to this medium before. At first they were shy and apprehensive in using the display unit and were discouraged when the computer signed them off or gave them corrective feedback. They tended to blame themselves many times for mechanical failures that were really not their fault. It must be remembered that these students had a long history of failure and frustration in their attempts at learning and their frustration at this new obstacle was not unexpected.

As students became more adept at using the computer equipment, however, this frustration seemed to disappear. They tended to transfer more and more blame to the machine and began to recognize that their inability to learn was not necessarily a result of their lack of ability. After several sessions, they seemed anxious to get started at their learning task, and many worked at the student terminal for an hour or an hour and a half without a break, even though they were allowed to take one at any time. This is somewhat contrary to the findings of Fletcher and Atkinson (1972) and Quinn (1966) who reported that learning performance deteriorates when CAI sessions run longer than 20-30 minutes. It does, however, support research done by Green (1967), Hess and Tenezakis (1971), Fletcher and Atkinson (1972), Hansen (1971), and Hankin, Smith and Smith (1967) who found the computer to have an extraordinarily positive effect on disadvantaged learners. These individuals found that the computer offers relief for these students from interacting with human authority figures and tend to create feelings in students that the computer is an "expert" whom they come

to rely upon and trust. These same feelings seem manifest in this study.

A second factor which seemed to have an effect on the positive attitudes characteristic of the CAI group was the novelty of the situation. These learners were brought to the University once a week for a two hour session. In this session they were permitted to work at their own pace, take reasonable breaks, and did not have to conform to the rules of a traditional school environment. It would be interesting to assess the attitudes of these same learners if this study had been conducted at terminals located at their respective schools under the direction of regular school officials.

The lack of correlation between achievement and attitude found in this study contributes to similar findings by Feldman and Sears (1970). Using a Behavior Survey Instrument, they found that the learner's classroom behavior had less to do with his achievement in the subject in which CAI instruction was given than is normally the case. That is, the correlations between behavior and achievement are less in the subject in which CAI is given. Feldman and Sears concluded that for learners who are not like the typically academically-oriented student, CAI allows for different responses to the instructional situation without the usual debilitating effects on achievement. If attitude can be considered a contributing factor to behavior, a similar conclusion might be drawn from this study about the effects of CAI and programmed instruction.

A further finding of this study was that students using the computer system spent an average of 18 minutes longer at the instructional task than those using the programmed text. Spread over several months or over a year, this difference could represent a significant savings in time and could greatly influence a decision to use a programmed text rather than the computer medium. Before making such a decision, however, a number of factors seem worth considering. To begin with, the learners using the computer system were for the most part unfamiliar with the typewriter keyboard. As a result, they spent many minutes searching for letters on the keyboard so they could make the typed responses required of many items. Further study might be done to see if facility with a typewriter would contribute to a saving in instructional time.

It is true, of course, that much time in computer assisted instruction is spent in such activities as waiting for access units to position instructional segments, changing audio reels, and listening to audio messages that cannot be sped up to suit the learner. Instructional time recorded by the computer can be somewhat deceiving, however, because it records "on-line" time, that is, time spent "signed-on" to the computer terminal. This includes time spent at breaks, talking with the teacher or proctor, and in assorted other interruptions of actual instructional time. Therefore, it is difficult to measure actual time spent in instruction.

Conclusions

The data obtained from this investigation adds tentative support to the notion that self-instructional programs in programmed

texts and under computer control can be used effectively to individualize the teaching of reading. Whether a programmed text or a computer-based display unit can individualize more effectively may not be as important as the fact that students can benefit from a program that accommodates their individual learning style so that learning can be more effectively expedited and facilitated. If either of these media or a combination of the two are effective in adjusting instruction to the learner's level of achievement, interest, and need, then this may be the most important reason for using one or the other until further research can be done to discover the significant benefits of each.

One advantage which seems to have emerged from using the computer in this study is that students reacted very positively to it as a teaching medium. Perhaps this fact is more indicative of the computer's instructional value than the student's achievement. Research cited earlier in this study has pointed out repeatedly that the removal of the human authority figure has great effect on the disadvantaged or unsuccessful learner. Perhaps the removal of the irritating personality factors which are very often present in traditional classroom instruction adds a crucial dimension of self-esteem and success vital to the effective facilitation of reading instruction. This is certainly an area which needs further research since it appears likely that attitude toward instruction might be an important variable in assigning specific students to certain instructional situations. Assignment might be made according to student preference or in terms of the teacher's judgement of important student needs. In any case, it appears that

attitude toward a specific medium might prove useful as diagnostic data which might be of assistance in planning learning experiences for differing students.

Bibliography

Campbell, D. T. & Stanley, J. C. Experimental and quasi-experimental designs for research. Chicago: Rand McNally & Co., 1963.

Dick, W. The development and current status of computer based instruction. American Educational Research Journal, 1965, 2(1), 41-55.

Feldman, D. H. & Sears, P. G. Effects of computer assisted instruction on children's behavior. Educational Technology, 1970 10, 11-14.

Fletcher, J. D., & Atkinson, R. C. An evaluation of the Stanford CAI program in initial reading. Journal of Educational Psychology, 1972, 63(6), 597-602.

Fry, E. How effective is programmed instruction in the teaching of reading? Paper presented at Thirteenth Annual Convention of the International Reading Association, Boston, April 27, 1968. ED026219.

Goss, V. A new approach to reading. Journal of Programmed Reading, April 1964, 1-3.

Green, R. G. Preliminary studies of initial reading instruction for disadvantaged children using computer assisted instruction. Paper presented at Southeastern Psychological Association, Atlanta, April 1967.

Groff, P. Comparisons of individualized and ability grouping approaches to teaching reading: a supplement. Elementary English, 1964, 41(3), 238-241.

Hankin, E. K., Smith, E. H., & Smith, T. A. The development of prevocational education literacy courses for use with computer-assisted instruction of disadvantaged youths and adults. Final Report. Project No. 6-1458, Grant No. OEG2-6-001458-1540 Washington, D.C.: Office of Education, U.S. Department of Health, Education, and Welfare, Bureau of Research, June 1967.

Hansen, D. N. A rural country computer related instructional technology project, End of Project Report, August 1, 1971, Florida State University, Computer Assisted Instruction Center.

Hess, R. D. & Tenezakis, M.D. The computer as a socializing agent: some socioaffective outcomes of CAI. Stanford, California: Stanford Center for Research and Development in Teaching, September, 1971.

Jacobs, P. I., Maier, M. H., & Stolurow, L. M. A guide to evaluating self-instructional programs. New York: Holt, Rinehart, and Winston, Inc., 1966.

Johnson, R. Individualized and basal reading programs. Elementary English, 1965, 42(8), 902-904.

Kaufman, M. Sullivan programmed reading at burgess elementary school. Sturbridge, Massachusetts, Boston: Massachusetts State Department of Education, 1968. ED 028 908.

Knezevich, S. J., & Eye, G. G. (Eds.), Instructional Technology and the School Administrator, American Association of School Administrators, 1970.

Majer, J. Computer assisted instruction and reading. Viewpoints, 1972, 48, 77-98.

Mull, P. A comparison of computer assisted instruction and a programmed workbook to teach the initial teaching alphabet and transliteration to inservice teachers. Unpublished doctoral dissertation, The Pennsylvania State University, 1973.

Peters, E. L., & Rookey, T. J. The effects of video taped broadcast on student behavior, teacher attitude, and utilization of ETV. Harrisburg, Pennsylvania: Bureau of Research, Pennsylvania Department of Education, 1969.

Phillips, T. G. A comparison of the effectiveness of a programmed text and a computer based display unit media in teaching FORTRAN IV. Unpublished doctoral dissertation, University of Missouri-Columbia, 1971.

Quinn, E. M. A CAI reading program - preliminary field test. IBM Research Report NC 576, Yorktown Heights, 1966.

Ruddell, R. B. The effect of four programs of reading instruction with varying emphasis of the regularity of grapheme-phoneme correspondences and the relation of the Language to the meaning of adjustment on first grade reading. Report of Research Project No. 2699, Berkeley, University of California, 1965.

Spencer, D. Individualized versus a basal reader program in rural communities - grades one and two. The Reading Teacher, 1967, 21, 11-17.

Sullivan Associates. Programmed Reading Series, Grades 1-3, New York: Webster Division, McGraw-Hill, 1964.

Suppes, P. Computer technology and the future of education, Phi Delta Kappan, 1968, 49(8), 420-23.

Talbert, D. & Merritt, C. B. The relative effectiveness of two approaches to the teaching of reading in grade V. The Reading Teacher, 1965, 19(3), 183-186.